Ordering number : EN2276B



Monolithic Linear IC

LA1175, 1175M

FM Front End For Car Radio, Home Stereo Applications

Functions

- Double-balanced type MIX, PIN diode drive AGC output, MOS FET gate drive AGC output, keyed AGC, differential IF amplifier, buffer amplifier for oscillation, local oscillation.

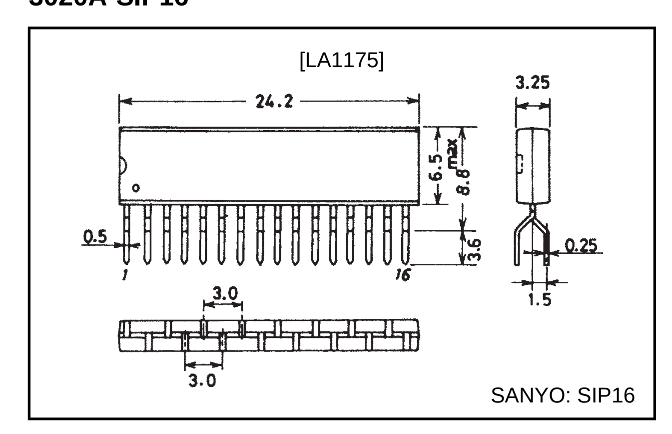
Features

- By using the keyed AGC system, which is effective in improving the sensitivity suppression characteristic, in combination with the antenna damping AGC (PIN diode driver on chip) and MOS FET 2nd gate drive AGC, the intermodulation characteristic for a large undesired signal is greatly improved. It is also possible to use the keyed AGC system in combination with the antenna damping AGC or MOS FET 2nd gate drive AGC.
- The temperature characteristic and noise figure are improved. The same supply voltage makes it easy to use the LA1175, 1175M.

Package Dimensions

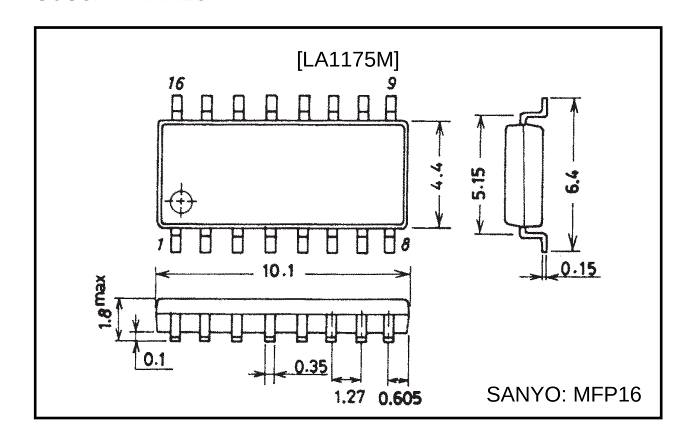
unit: mm

3020A-SIP16



unit: mm

3035A-MFP16



Specifications

Maximum Ratings at Ta=25°C

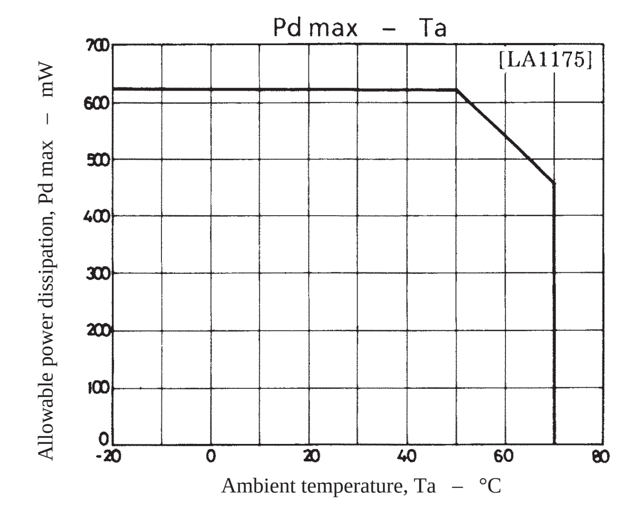
Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max	Pins 4, 14	9.5	V
		Pins 8, 9	15	V
Allowable power dissipation	Pd max	LA1175 : Ta≤70°C	460	mW
		LA1175M : Ta≤70°C Mounted on PCB (bakelite) of 40mm×48mm×1.8mm²	435	mW
Operating temperature	Topr		–20 to +70	°C
Storage temperature	Tstg		–40 to +125	°C

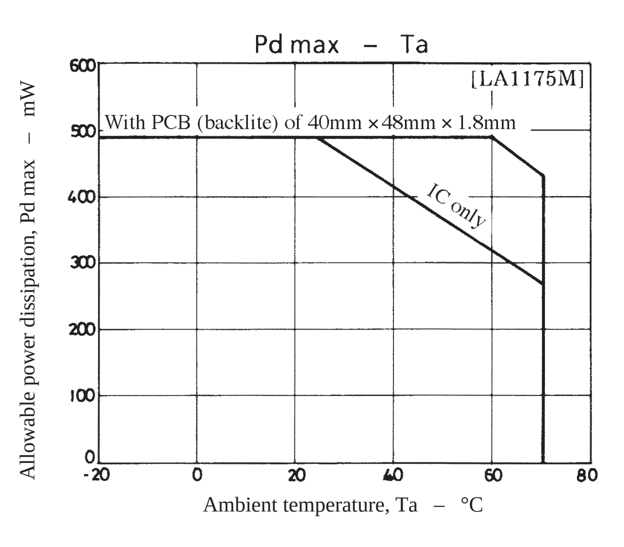
Operating Conditions at Ta=25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}	Pin 4, 8, 9, 14	8	V
Operating voltagerange	V_{CC} op		8 to 9	V

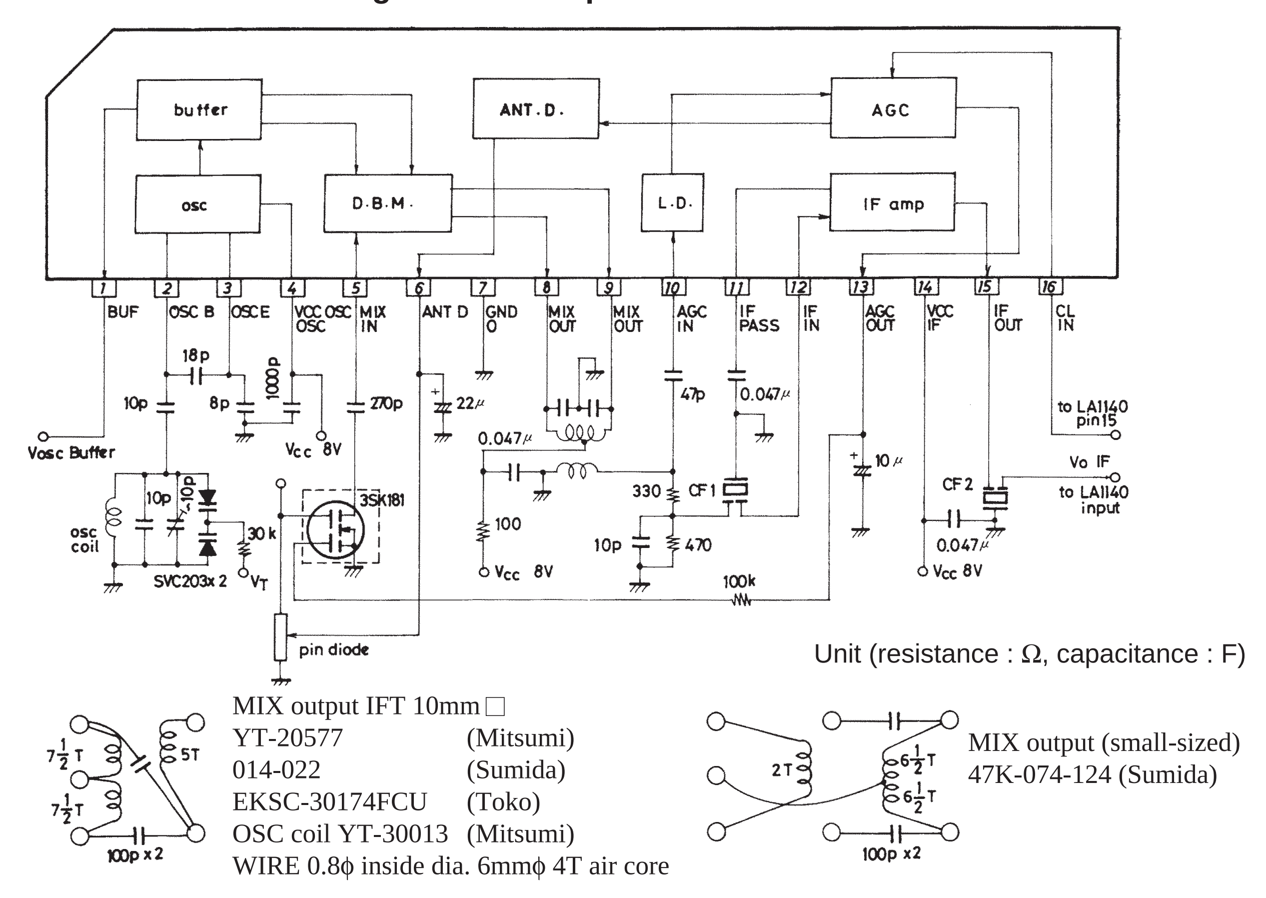
Electrical Characteristics at Ta=25°C, V_{CC}=8V, See specified Test Circuit.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	I_{CC}	Pins 4, 8, 9, 14 : no input	23.0	28.0	33.0	mA
AGC high-level voltage	V_{AGCH}	V_{IN}=0dBµ, V_{CL}=4V	7.6	7.9		V
AGC low-level voltage	V_{AGCL}	V_{IN}=100dBµ, V_{CL}=4V		0.2	0.7	V
IF input resistance	R_{IN}		260	330	400	Ω
AGC control input	$V_{CL}7$	V_{IN}=100dBµ, V_{AGC}=7V		0.25	0.5	V
	$V_{CL}2$	V_{IN}=100dBµ, V_{AGC}=2V	1.1	1.6	2.1	V
Voltage gain	A_V	LA1175 : V_{IN}=75dBµ	99	102	105	dBµ
		LA1175M : V_{IN}=75dBµ	97	100	103	dBµ
Input limiting voltage	V_{INlim}	LA1175 : Referenced to V_{IN}=110dBµ	81	88	95	dBµ
		LA1175M : Referenced to V_{IN}=110dBµ	80	87	94	dBµ
AGC input voltage	V_{iAGC}	V_{AGC}=2V	67	74	81	dBµ
Saturation output voltage	V_{OUT}	LA1175 : V_{IN}=110dBµ	110	114		dBµ
		LA1175M : V_{IN}=110dBµ	100	113		dBµ
OSC BUFF output	V_{OSC} BUFF	1kΩ load	105	109		dBµ
ANT damping drive current	I_{ANT-D}	V_{IN}=100dBµ	4.5	6.0	8.0	mA





Equivalent Circuit Block Diagram and Peripheral Circuit : LA1175



Unit (resistance : Ω, capacitance : F)

MIX output IFT 10mm□
YT-20577 (Mitsumi)
014-022 (Sumida)
EKSC-30174FCU (Toko)
OSC coil YT-30013 (Mitsumi)
WIRE 0.8ϕ inside dia. 6mmϕ 4T air core

MIX output (small-sized)
47K-074-124 (Sumida)

Equivalent Circuit Block Diagram and Peripheral Circuit : LA1175M

MIX output IFT 10mm□
YT-20577 (Mitsumi)
014-022 (Sumida)
EKSC-30174FCU (Toko)
OSC coil YT-30013 (Mitsumi)
WIRE 0.8ϕ inside dia. 6mmϕ 4T air core

MIX output (small-sized)
47K-074-124 (Sumida)

Unit (resistance : Ω, capacitance : F)

Internal Connection Diagram : LA1175

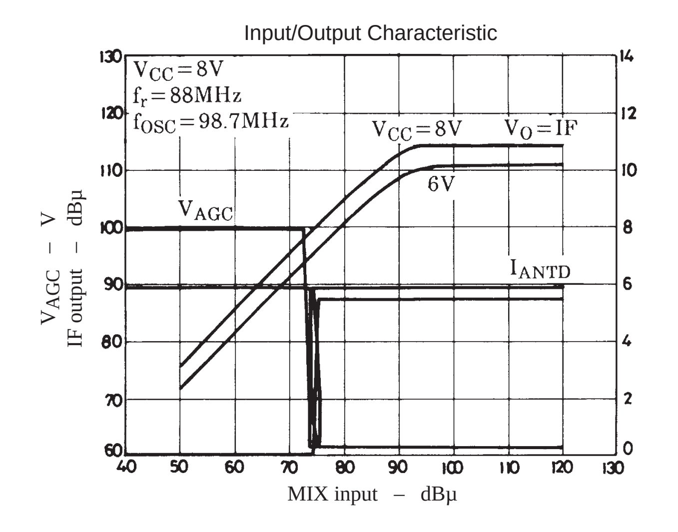
OSC E 3, OSC B 2, OSC VCC 4, MIX IN 5, MIX OUT 8, MIX OUT 9, IF Bypass 11, IF input 12, IF VCC 14, IF OUT 15

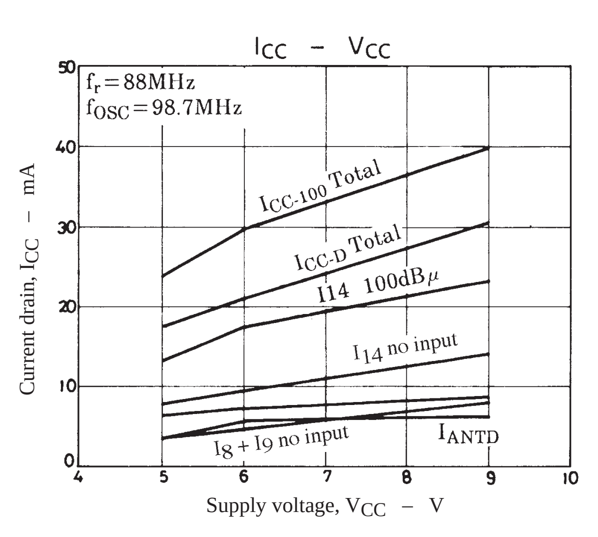
OSC, OSC BUFFER AMP, MIX, IF AMP, OSC BUFF, LEVEL DET, RF AGC, PIN DIODE DRIVER, COMPARATOR

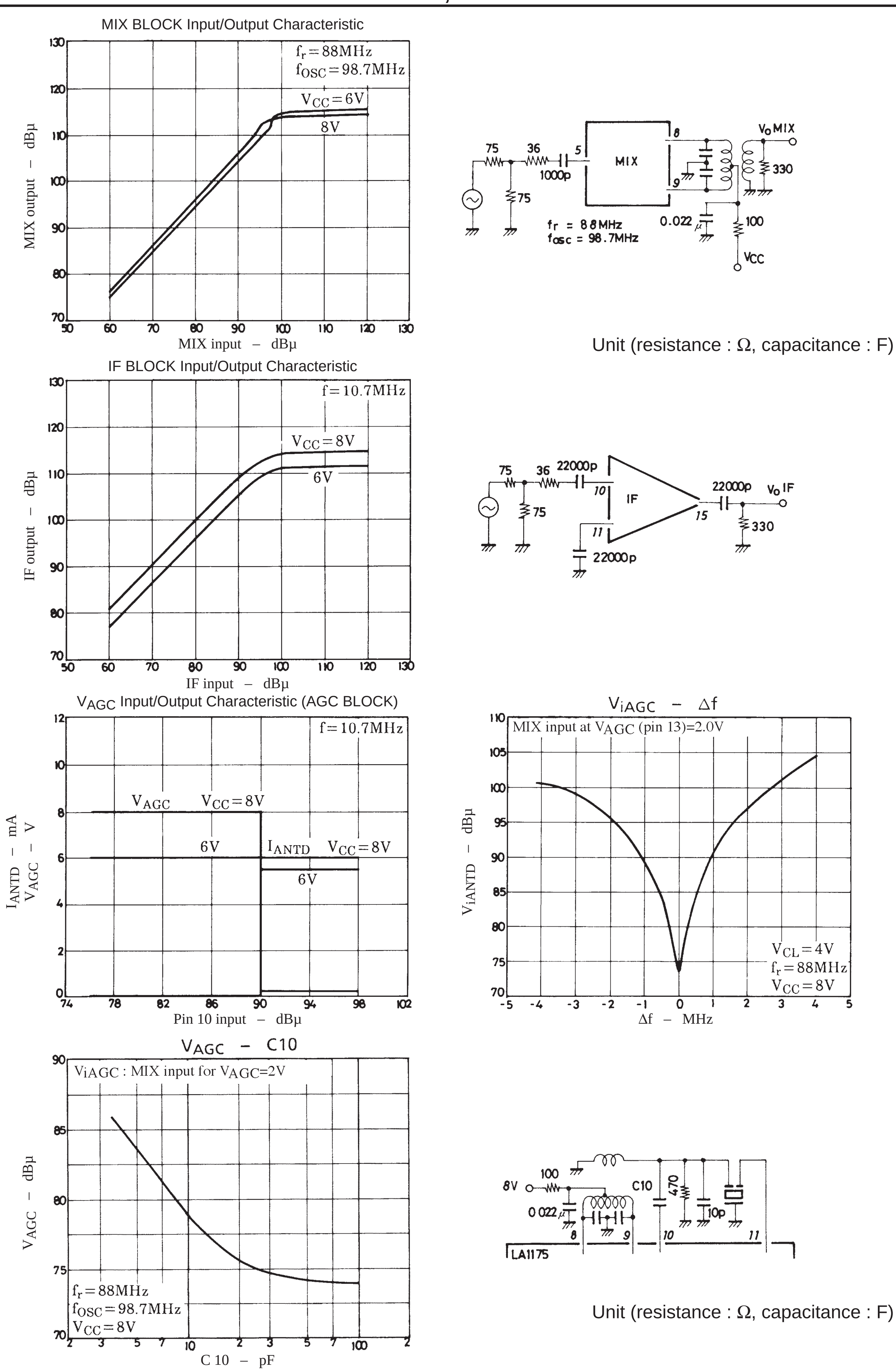
VCC, 330, 2.2k, 12k, 1k, 250

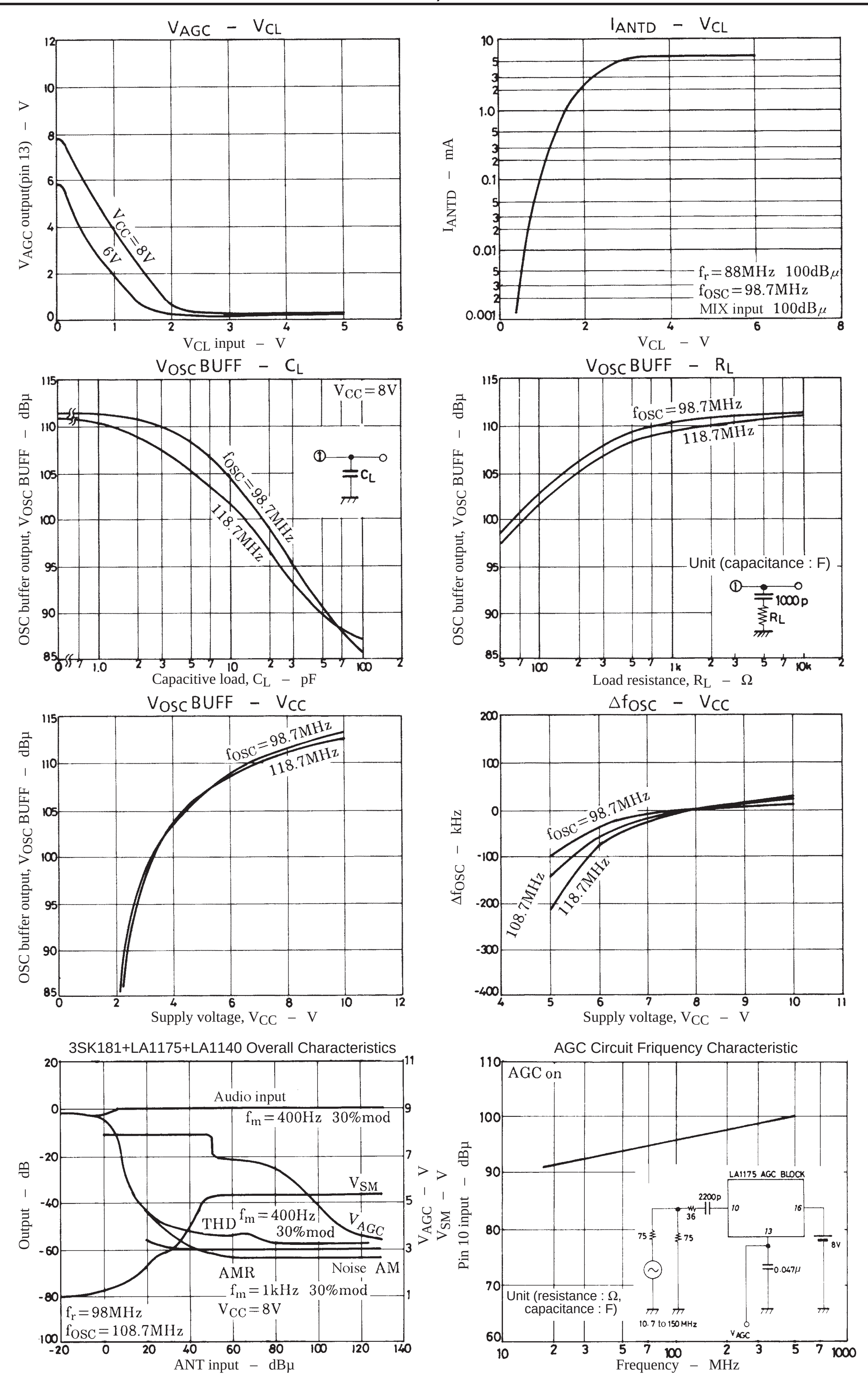
1 OSC BUFF, 10 AGC IN, 7 GND, 13 AGC OUT, 16 VCL INPUT, 6

Unit (resistance : Ω, capacitance : F)



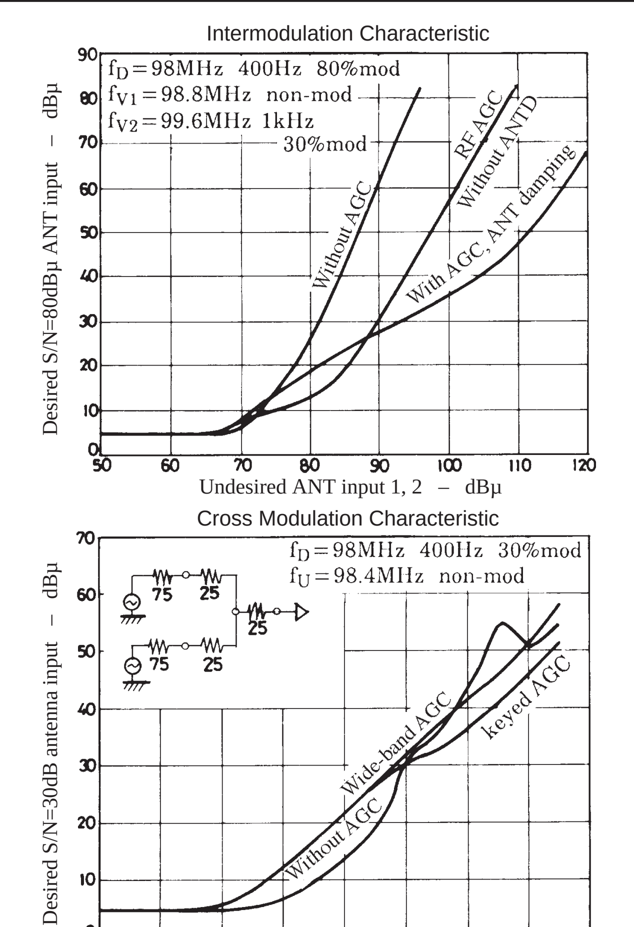



MIX BLOCK Input/Output Characteristic
fr=88MHz
fOSC=98.7MHz
VCC=6V
8V
MIX output – dBμ
MIX input – dBμ
75
36
1000p
5
MIX
8
9
VO MIX
330
75
fr = 88MHz
fosc = 98.7MHz
0.022μ
100
VCC
Unit (resistance : Ω, capacitance : F)
IF BLOCK Input/Output Characteristic
f=10.7MHz
VCC=8V
6V
IF output – dBμ
IF input – dBμ
75
36
22000p
10
IF
11
22000p
15
22000p
VO IF
330
75
VAGC Input/Output Characteristic (AGC BLOCK)
f=10.7MHz
VAGC
VCC=8V
6V
IANTD
VCC=8V
6V
IANTD – mA
VAGC – V
Pin 10 input – dBμ
ViAGC – Δf
MIX input at VAGC (pin 13)=2.0V
VCL=4V
fr=88MHz
VCC=8V
ViANTD – dBμ
Δf – MHz
VAGC – C10
ViAGC : MIX input for VAGC=2V
fr=88MHz
fOSC=98.7MHz
VCC=8V
VAGC – dBμ
C 10 – pF
8V
100
0.022μ
C10
470
10p
8
9
10
11
LA1175
Unit (resistance : Ω, capacitance : F)

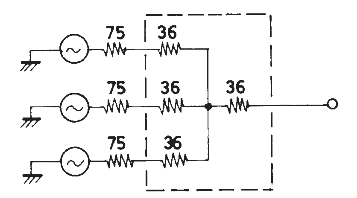

VAGC – VCL
VAGC output(pin 13) – V
VCC=8V
6V
VCL input – V
IANTD – VCL
IANTD – mA
fr=88MHz 100dBμ
fOSC=98.7MHz
MIX input 100dBμ
VCL – V
VOSC BUFF – CL
OSC buffer output, VOSC BUFF – dBμ
VCC=8V
fOSC=98.7MHz
118.7MHz
CL
Capacitive load, CL – pF
VOSC BUFF – RL
fOSC=98.7MHz
118.7MHz
Unit (capacitance : F)
1000p
RL
Load resistance, RL – Ω
VOSC BUFF – VCC
OSC buffer output, VOSC BUFF – dBμ
fOSC=98.7MHz
118.7MHz
Supply voltage, VCC – V
ΔfOSC – VCC
ΔfOSC – kHz
fOSC=98.7MHz
108.7MHz
118.7MHz
Supply voltage, VCC – V
3SK181+LA1175+LA1140 Overall Characteristics
Output – dB
VAGC – V
VSM – V
Audio input
fm=400Hz 30%mod
VSM
fm=400Hz
30%mod
THD
VAGC
AMR
Noise AM
fm=1kHz 30%mod
VCC=8V
fr=98MHz
fOSC=108.7MHz
ANT input – dBμ
AGC Circuit Friquency Characteristic
Pin 10 input – dBμ
AGC on
LA1175 AGC BLOCK
2200p
36
75
75
0.047μ
8V
10.7 to 150 MHz
VAGC
Unit (resistance : Ω, capacitance : F)
Frequency – MHz

Intermodulation Characteristic

Cross Modulation Characteristic

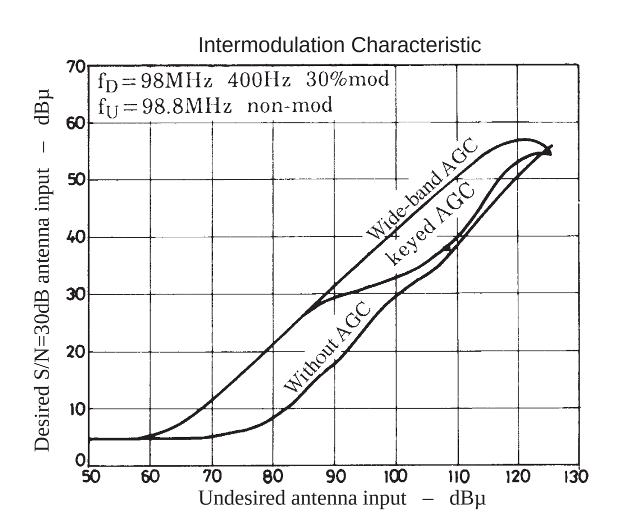






Unit (resistance : Ω)

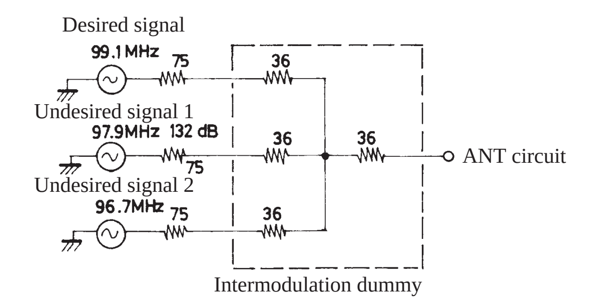
Intermodulation Characteristic



Improvement of IM characteristic in strong undesired input signal mode when ANT damping AGC is used (LA1174).

Test conditions

- f_D : 99.1MHz, f_m=400Hz 100% mod
- f_{U1} : 97.9MHz non-mod SG open 132dBµ
- f_{U2} : 96.7MHz f_m=1kHz 100% mod



Unit (resistance : Ω)

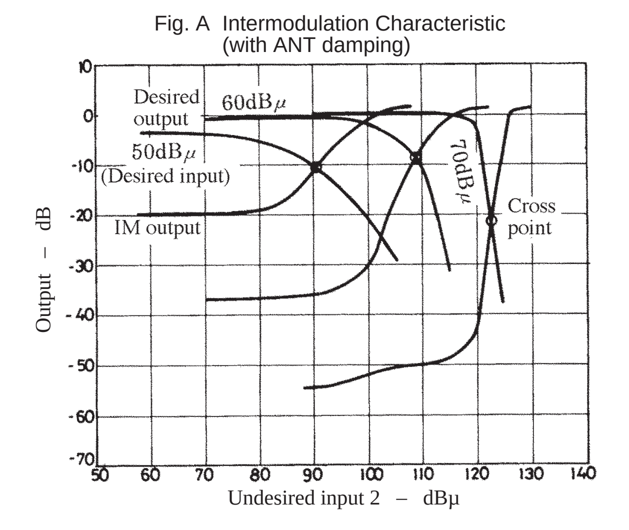
Cross point

The open input level of undesired signal 2 at which the IM output and desired signal output are at the same level.

IM output	• Desired signal	: Non-mod at each specified input
	• Undesired signal 1	: Non-mod at input 132dBμ (SG open)
	• Undesired signal 2	: 100% mod with input variable
Desired signal output	• Desired signal	: 100% at each specified input
	• Undesired signal 1	: Non-mod at input 132dBμ (SG open)
	• Undesired signal 2	: Non-mod with input variable

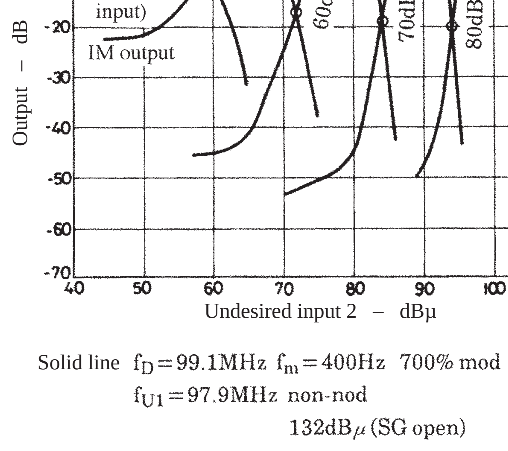
	Desired input level	50dBμ	60dBμ	70dBμ	80dBμ	
Cross point	With ANT damping RF AGC and ANTD AGC	90.5dBμ	109dBμ	123dBμ	Test impossible	Refer to Fig. A.
Cross point	Without ANT damping RF AGC only	59.5dBμ	72dBμ	89dBμ	98dBμ	Refer to Fig. B.
	Improvement	31dB	37dB	34dB		

Fig. A Intermodulation Characteristic (with ANT damping)

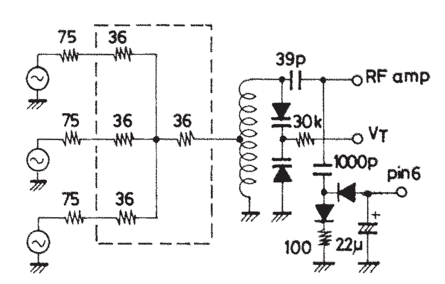


Solid line f_D = 99.1MHz f_m = 400Hz 700% mod
f_{U1} = 97.9MHz non-nod
132dBμ (SG open)
f_{U2} = 96.7MHz non-mod
Broken line f_D = 99.1MHz non-mod
f_{U1} = 97.9MHz non-mod
132dBμ (SG open)
f_{U2} = 96.7MHz 1kHz 100% mod

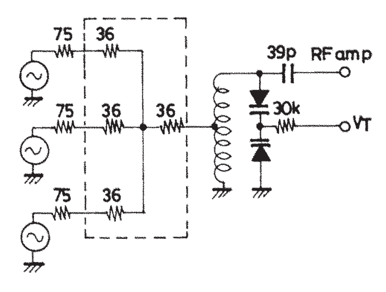
Fig. B Intermodulation Characteristic (with ANT damping)



Solid line f_D = 99.1MHz f_m = 400Hz 700% mod
f_{U1} = 97.9MHz non-nod
132dBμ (SG open)
f_{U2} = 96.7MHz non-mod
Broken line f_D = 99.1MHz non-mod
f_{U1} = 97.9MHz non-mod
132dBμ (SG open)
f_{U2} = 96.7MHz 1kHz 100% mod



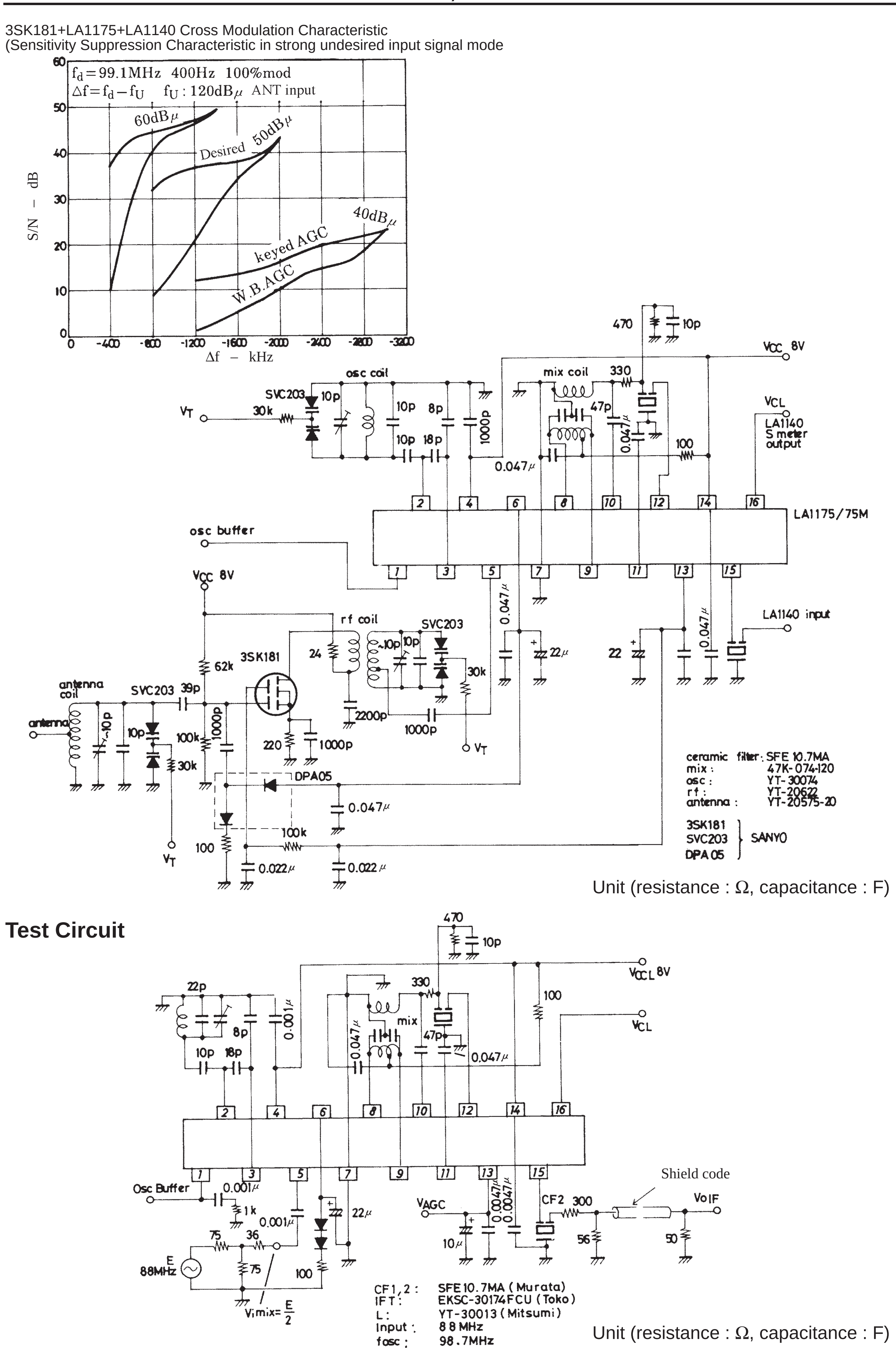
Intermodulation dummy



Intermodulation dummy

Unit (resistance : Ω, capacitance F)

3SK181+LA1175+LA1140 Cross Modulation Characteristic
(Sensitivity Suppression Characteristic in strong undesired input signal mode

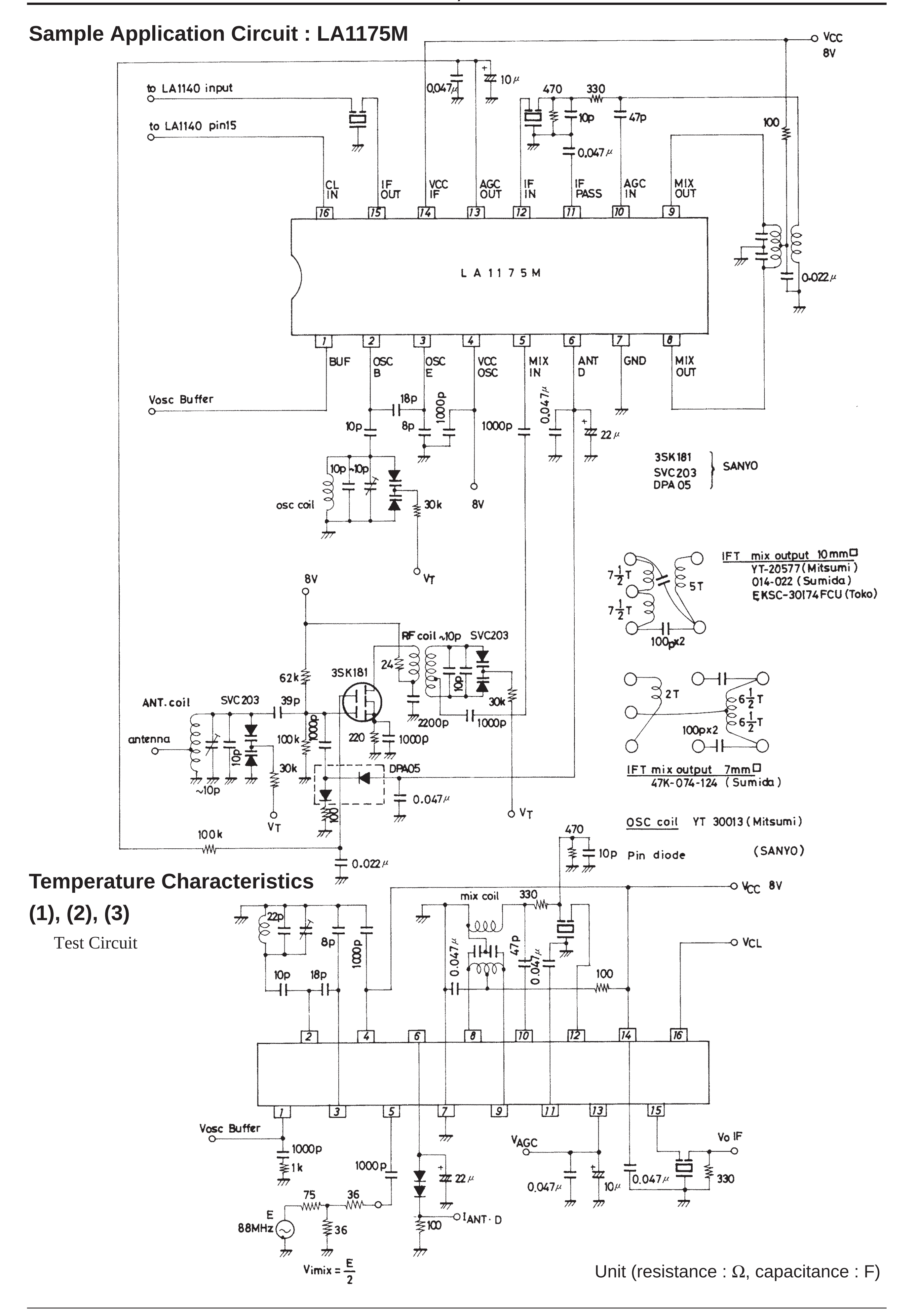


Unit (resistance : Ω, capacitance : F)

Test Circuit

Unit (resistance : Ω, capacitance : F)

Sample Application Circuit : LA1175M

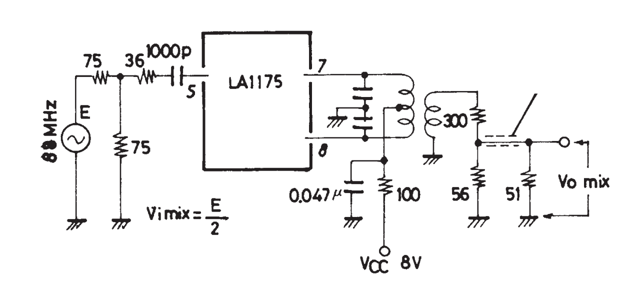


Temperature Characteristics (1), (2), (3)

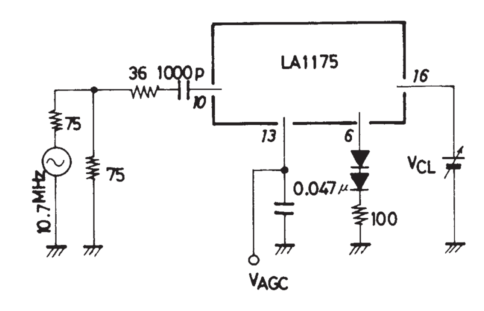
Test Circuit

Unit (resistance : Ω, capacitance : F)

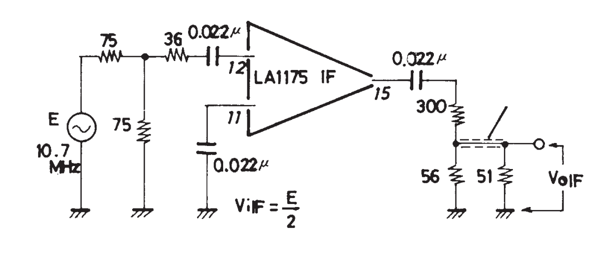
Temperature Characteristics (4)



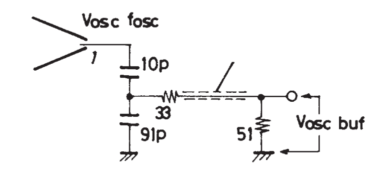
Temperature Characteristics (5)



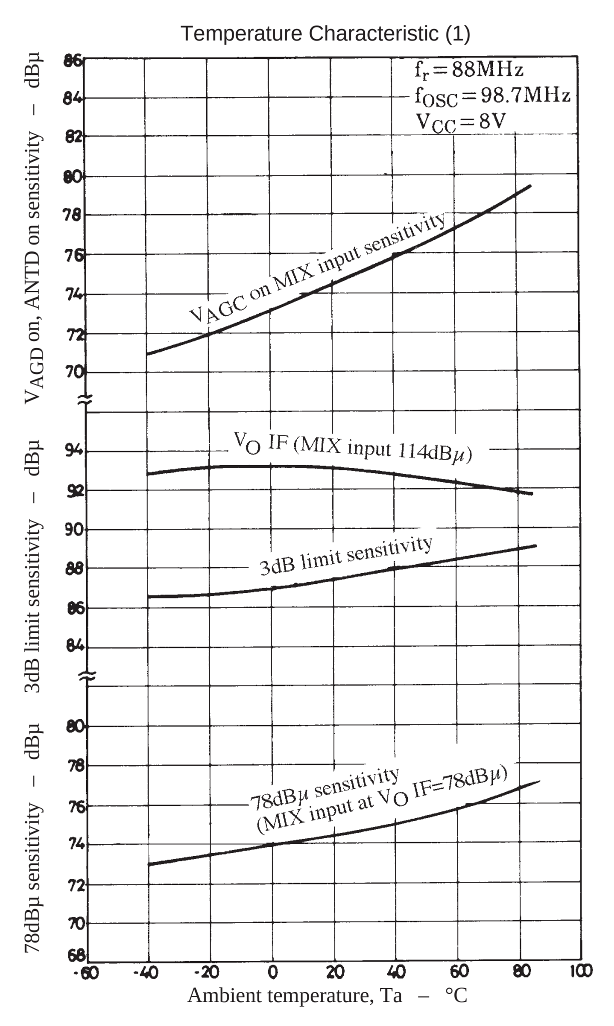
Temperature Characteristics (6)

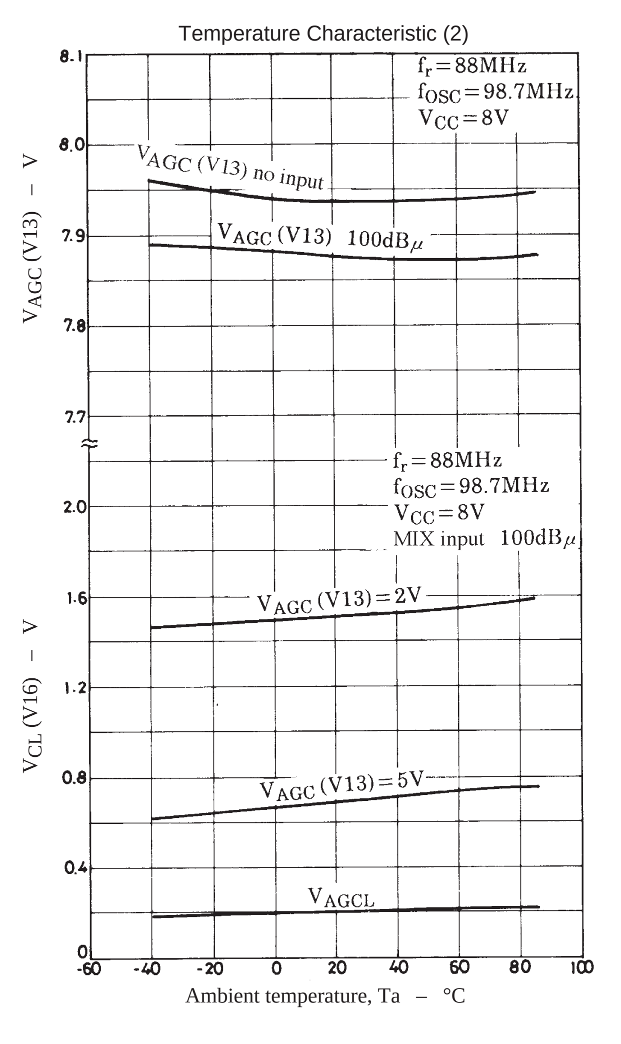


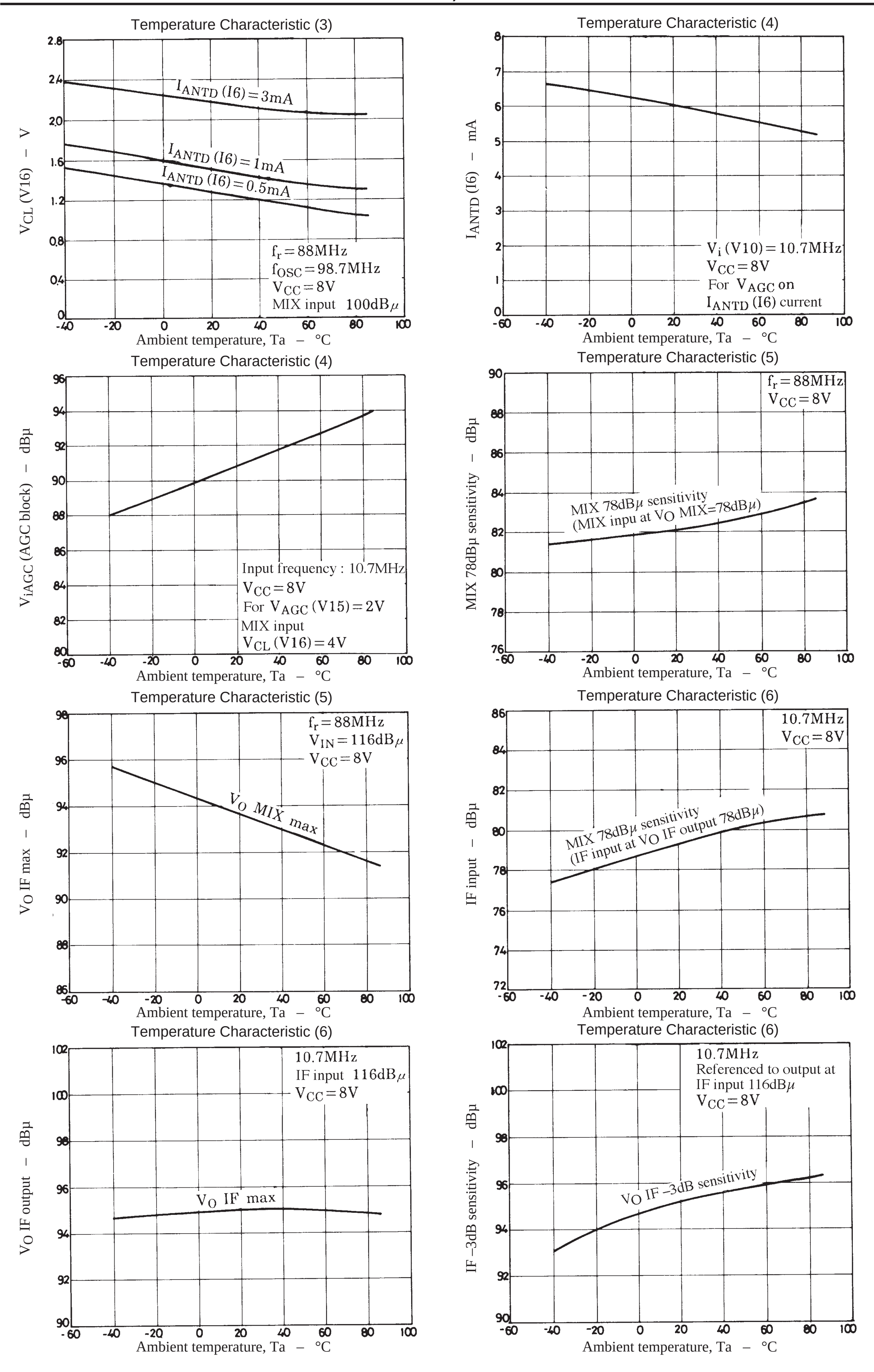
Temperature Characteristics (7)

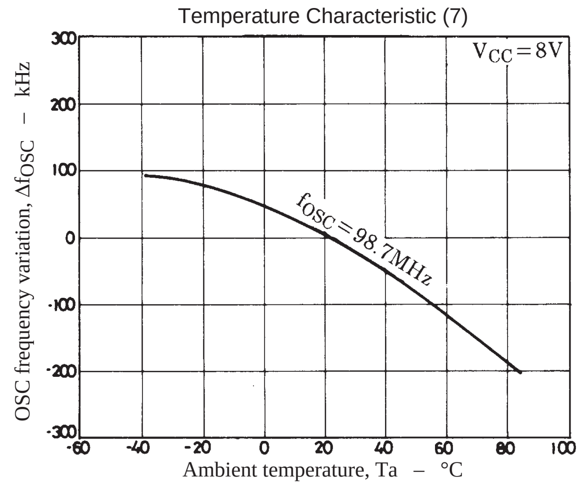


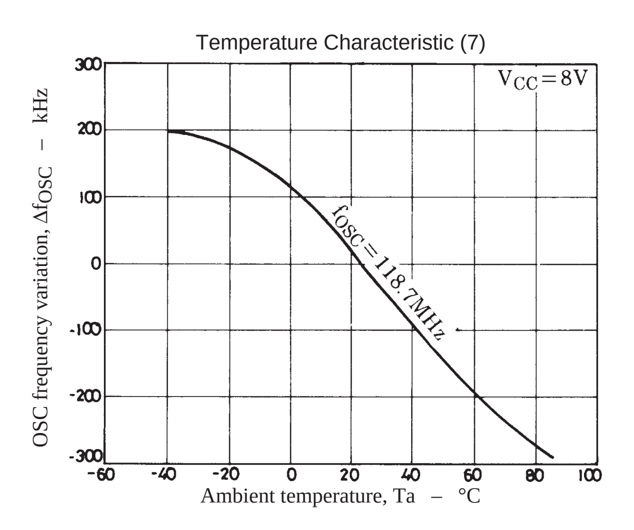
Unit (resistance : Ω, capacitance : F)

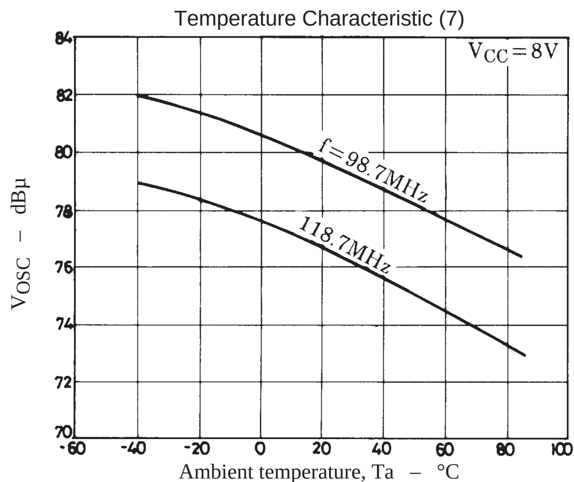





Temperature Characteristic (3)
IANTD (I6) = 3mA
IANTD (I6) = 1mA
IANTD (I6) = 0.5mA
fr = 88MHz
fOSC = 98.7MHz
VCC = 8V
MIX input 100dBμ
VCL (V16) – V
Ambient temperature, Ta – °C
Temperature Characteristic (4)
Vi (V10) = 10.7MHz
VCC = 8V
For VAGC on
IANTD (I6) current
IANTD (I6) – mA
Ambient temperature, Ta – °C
Temperature Characteristic (4)
Input frequency : 10.7MHz
VCC = 8V
For VAGC (V15) = 2V
MIX input
VCL (V16) = 4V
ViAGC (AGC block) – dBμ
Ambient temperature, Ta – °C
Temperature Characteristic (5)
fr = 88MHz
VCC = 8V
MIX 78dBμ sensitivity
(MIX inpu at VO MIX=78dBμ)
MIX 78dBμ sensitivity – dBμ
Ambient temperature, Ta – °C
Temperature Characteristic (5)
fr = 88MHz
VIN = 116dBμ
VCC = 8V
VO MIX max
VO IF max – dBμ
Ambient temperature, Ta – °C
Temperature Characteristic (6)
10.7MHz
VCC = 8V
MIX 78dBμ sensitivity
(IF input at VO IF output 78dBμ)
IF input – dBμ
Ambient temperature, Ta – °C
Temperature Characteristic (6)
10.7MHz
IF input 116dBμ
VCC = 8V
VO IF max
VO IF output – dBμ
Ambient temperature, Ta – °C
Temperature Characteristic (6)
10.7MHz
Referenced to output at
IF input 116dBμ
VCC = 8V
VO IF –3dB sensitivity
IF –3dB sensitivity – dBμ
Ambient temperature, Ta – °C







Description of AGC circuit in the LA1175, 1175M

The LA1175, 1175M are designed so that AGC is operated in the order shown below.

ANT damping (PIN diode) → MOS FET 2nd gate voltage control

(Attenuation)20dB (Attenuation)60dB

The following are the reasons why AGC is operated in this order.

(1) When a signal of 110dBμ or greater is applied to the varactor in the ANT circuit, intermodulation may occur. In this case, if AGC is operated in the order of MOS FET 2nd gate control AGC → ANT damping (PIN diode), the input to the varactor in the ANT circuit is not restricted unless a strong signal with AGC attenuation 60dB or greater is given. Therefore, AGC should be operated in the order shown above.

(2) If the two AGC loops (AGC loop (ANT damping) and AGC loop (MOS FET 2nd gate control)) are operated simultaneously, the transient response of AGC loses stability. Therefore, the order shown below is impracticable.

MOS FET 2nd gate control → ANT damping → MOS FET 2nd gate control.

Relation between keyed AGC and two AGC loops

For the LA1170, keyed AGC provides AGC attenuation control (RF MOS FET 2nd gate). For the LA1175, 1175M, however, there are two AGC loops as shown above. Therefore, keyed AGC must be applied to both of the two AGC loops. The LA1175, 1175M contain the ANT damping circuit to improve intermodulation in a strong field, but the prevention of intermodulation in a strong field and the improvement of the sensitivity suppression characteristic by keyed AGC are mutually exclusive as mentioned below.

Conditions	Desired signal	Weak field
	Undesired signals 1, 2	Strong field (Field strength in which the ANT circuit may cause intermodulation to occur)

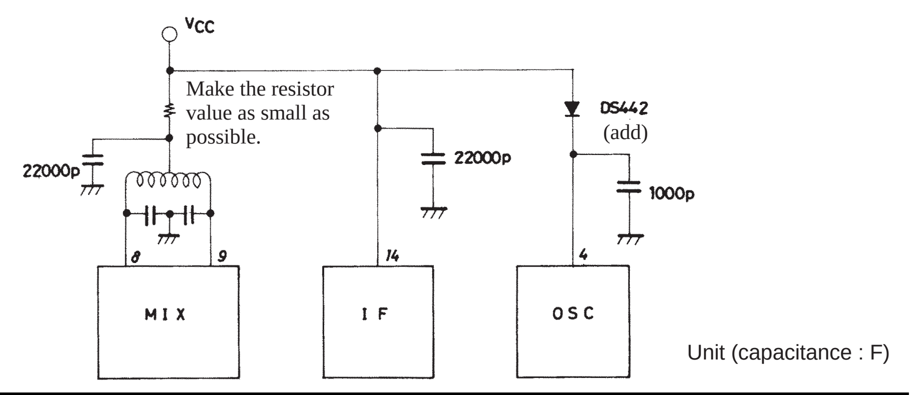
If keyed AGC is operated to cause AGC-OFF mode to be entered when a desired signal is received, the varactor in the ANT circuit may be distorted and intermodulation may occur, which means that it is meaningless for the LA1175, 1175M to contain the ANT damping circuit because it produces no effect. Therefore, the effect of the keyed AGC circuit in the LA1175, 1175M on the ANT damping circuit is made less than that in the LA1170 so that the above-mentioned problem does not arise. However, if the LA1175, 1175M are used under the same conditions as for the LA1170 (no ANT damping, pin 6 open), keyed AGC is operated in the same manner as for the LA1170.

Application circuit used in a very strong field

Since the LA1175, 1175M are designed to be operated from single supply, the dynamic range of the MIX output becomes narrower as compared with the dual-supply type (V_{CC} MIX=12V, other=8V) heretofore in use. IF an adjacent interference channel signal is very strong, the intermodulation characteristic at Δf=400kHz is deteriorated, because the dynamic range of the MIX output exceeds the limit, which causes a distortion to occur.

The following three countermeasures are available.

1. Q of the MIX coil is made higher to provide a higher selectivity.
   (Must be balanced with the detection band of the wide-band AGC)
2. The LA1175, 1175M are operated from dual supplies (Most ideal).
3. The application circuit shown below is used.



This catalog provides information as of September, 1997. Specifications and information herein are subject to change without notice.